

# NASA Science Mission Directorate Earth Science Division Applied Sciences Program



**Cyanobacteria Assessment Network**

***Blake A. Schaeffer***

**NASA Water Resources PI Meeting**

**April 26-28, 2016**



# *Project Title: Cyanobacteria Assessment Network*



## **Mission:**

Support the environmental management and public use of U.S. lakes and estuaries by providing a capability of detecting and quantifying algal blooms and related water quality using satellite data records.

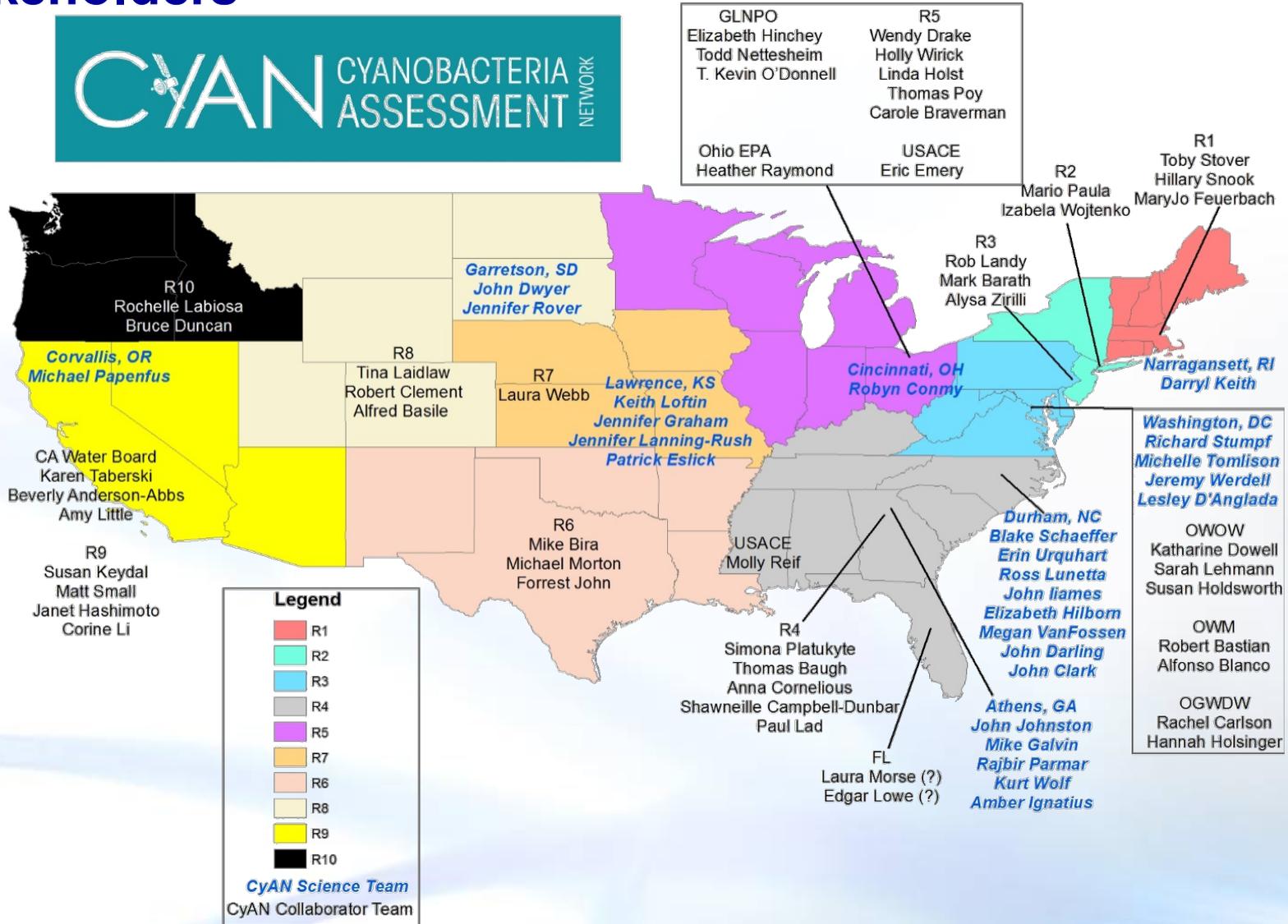
## **Objectives:**

- A. Create a standard and uniform approach for early identification of algal blooms that is useful and accessible to stakeholders of freshwater systems using the new set of satellites: Ocean Land Colour Instrument (OLCI) on Sentinel-3, Sentinel-2, Landsat and future NASA missions;
- B. Develop an information dissemination system for expedient public health advisory postings
- C. Better understand the connections between health, economic and environmental conditions to cyanobacteria and phytoplankton blooms.

# Project Title: Cyanobacteria Assessment Network



## Stakeholders

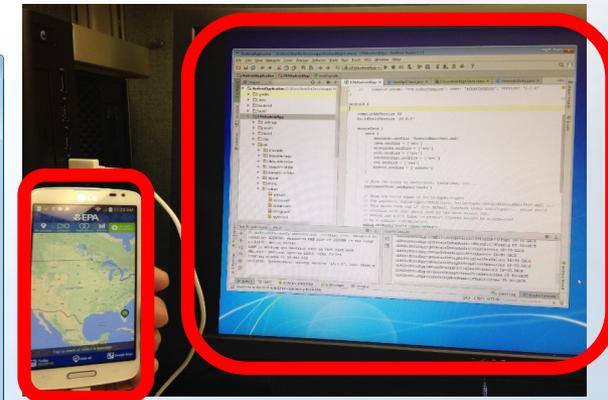
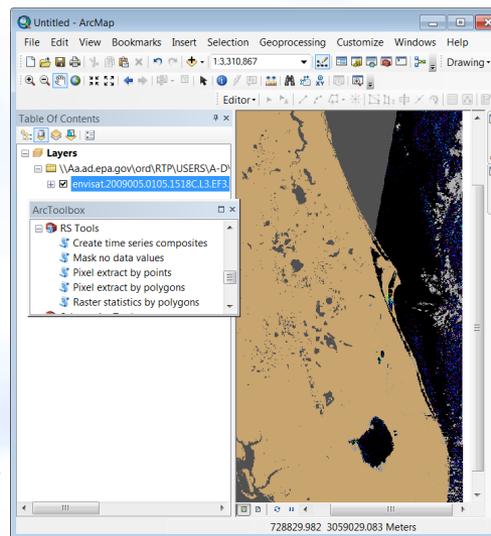
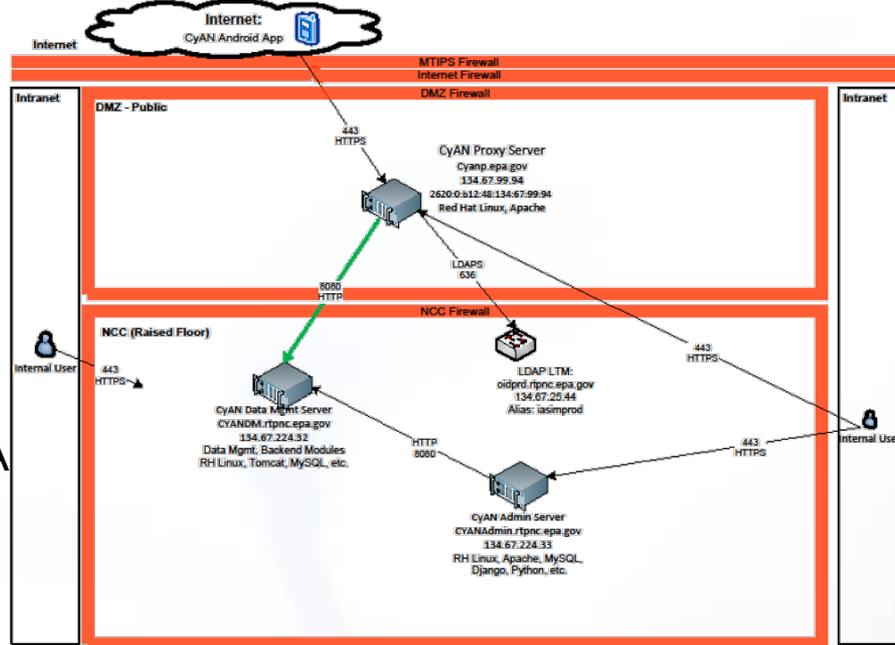


# Project Title: Cyanobacteria Assessment Network



## Tools

- Mobile Application Infrastructure
  - Administrative website
  - Data management module
  - Processing module
- EPA National Computing Center deployment
  - FedRAMP compliant, FISMA approved.
  - Proxied access, fire walls abound.
  - Future Cloud deployment possible
- Mobile app debugging:
  - IDE breakpoints, view code execution/results, see immediate effects of code changes.
- geoTIFF product configuration for GIS analysis
  - ArcGISToolbox for data extraction from geoTIFFs, beta testing by California



# Project Title: Cyanobacteria Assessment Network



## Tools

**CyAN Collaborators**

Newsfeed

Start a conversation

Schaeffer, Blake  
This figure provides the names and locations on the CyAN Science Team and CyAN Collaborator Team.

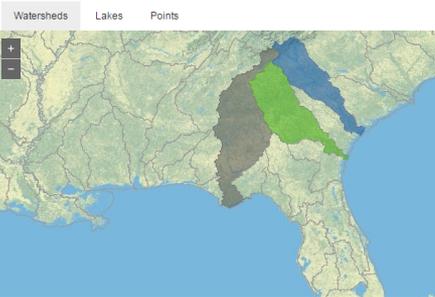
February 25 Like Reply

Schaeffer, Blake  
Welcome to the new CyAN Collaborators Sharepoint site. This site should allow all CyAN collaborators access to relevant documents, reports, and data.  
Friday, October 30, 2015 Like Reply

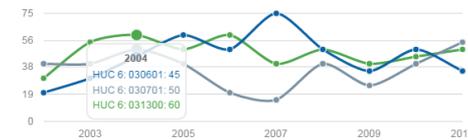
SHOW MORE POSTS

Sentinel-3 (OLCI) Updates Documents

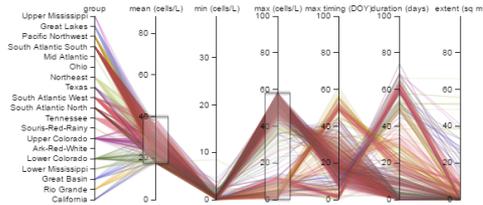
### CyAN Historic Data Dashboard



Cyanobacteria Annual Max Concentration (cells/L)



Graphical Bloom Properties Query Tool



CyAN Wet

## Get Started with EnviroAtlas

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### Cyanobacteria Assessment Network (CyAN) Project

EPA, NASA, NOAA, USGS

#### What is the CyAN Project?

The Cyanobacteria Assessment Network (CyAN) is a multi-agency project among the National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and EPA to develop an early warning indicator system using historical and current satellite data to detect algal blooms in U.S. freshwater systems. This research supports federal, state, and local partners in their monitoring efforts to assess water quality to protect aquatic and human health.

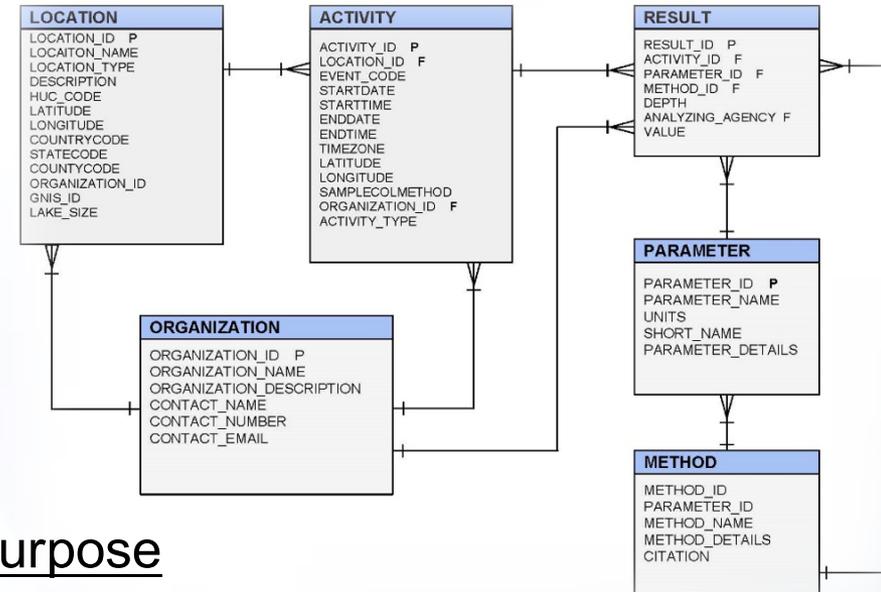
The project will:

- develop a uniform and systematic approach for identifying cyanobacteria blooms using ocean satellites across the contiguous United States;
- create a strategy for evaluation and refinement of algorithms across satellite platforms;
- identify landscape linkage postulated causes of chlorophyll-a and cyanobacteria blooms in freshwater systems;
- characterize exposure and human health effects using ocean color satellites in drinking water sources and recreational waters;
- characterize behavior responses and economic value of the early warning system using ocean satellites and mobile dissemination platform; and
- disseminate satellite data through an Android mobile application and [EnviroAtlas](#).

## Approach

### Target Data Criteria for Database Schema

- Natural and manmade lakes and ponds
- GoM Coastal data
- Temporal/spatial datasets within waterbody
  - Low, medium, and high concentrations for phytoplankton, pigments, toxins, WQ variables
- Sample metadata, methods, QA/QC plans



### Tiered Criteria for Field Data Fitness of Purpose

#### Quality Control Tiers

- Documentation -Study Design, Sample Collection/Processing, Analytical Methods
- Converging Lines of Evidence -Agreement between field values at a threshold basis

#### Interpretative Thresholds for Data Comparison, Algorithm Development and Validation

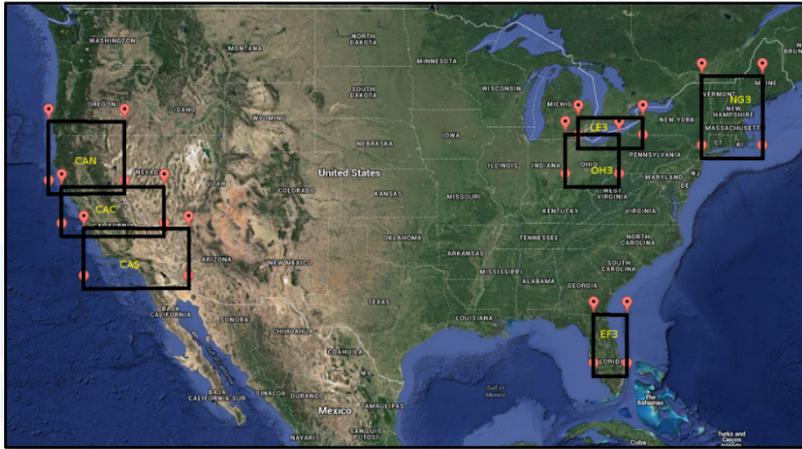
- World Health Organization Health Thresholds for Microcystins
- Using microcystins, chlorophyll, and cyanobacterial abundance
- Trophic Status Thresholds (e.g. Chlorophyll, Secchi Depth, Nutrients)

# Project Title: Cyanobacteria Assessment Network

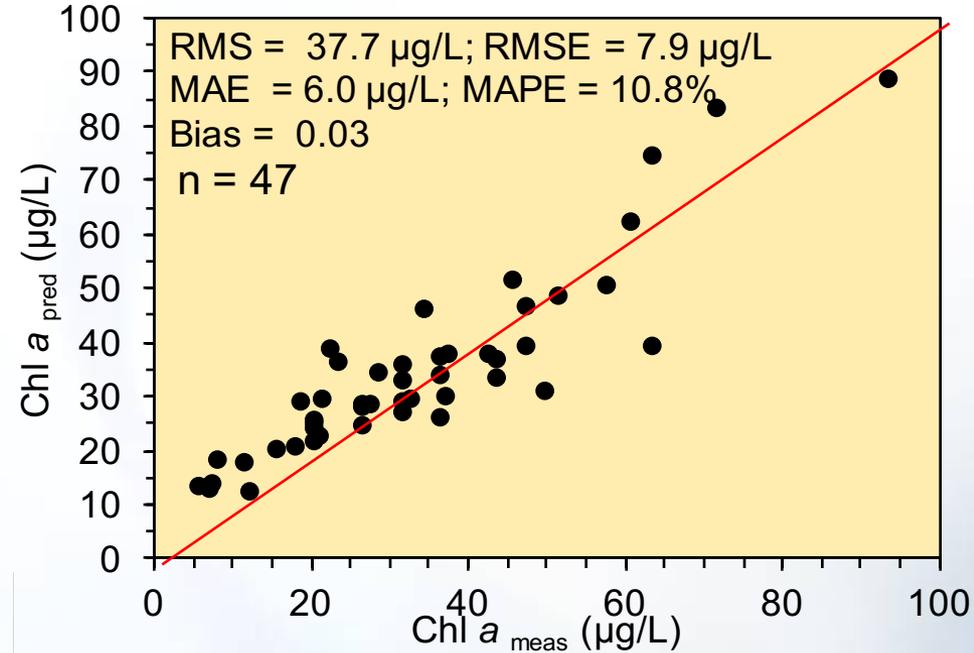


## Approach

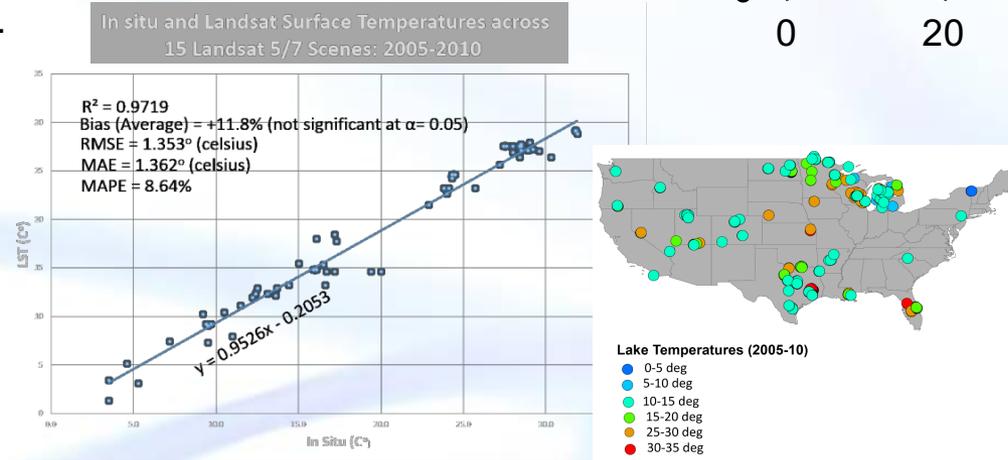
- Preliminary versions of NOAA cyanobacteria algorithms implemented into NASA standard processing software.



- 3 band reflectance model derived from USGS Landsat 7 & 8 surface reflectance products to predict chlorophyll (chl a) concentrations in lakes and ponds.

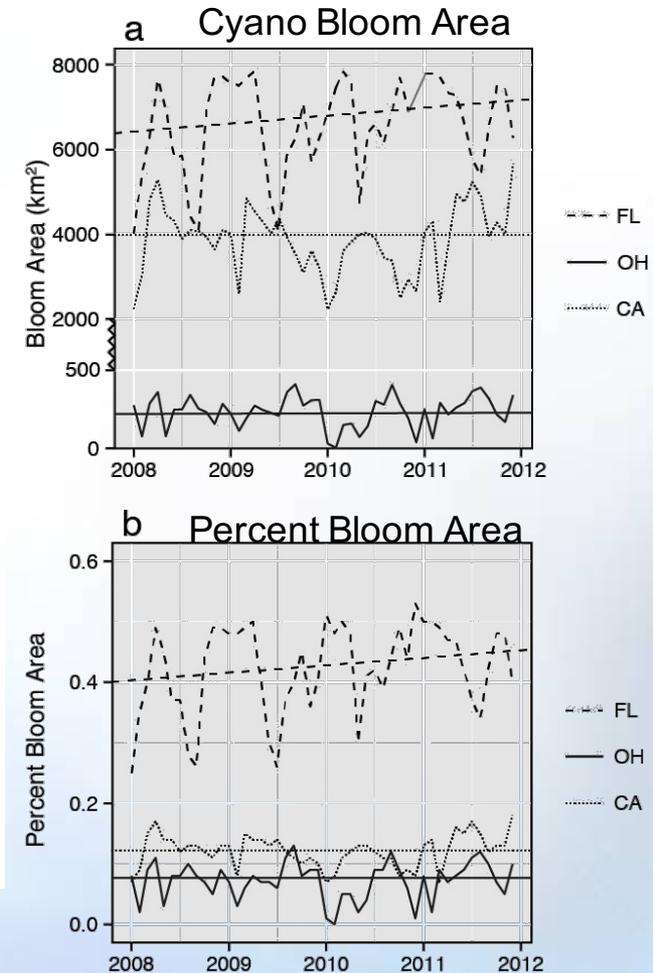
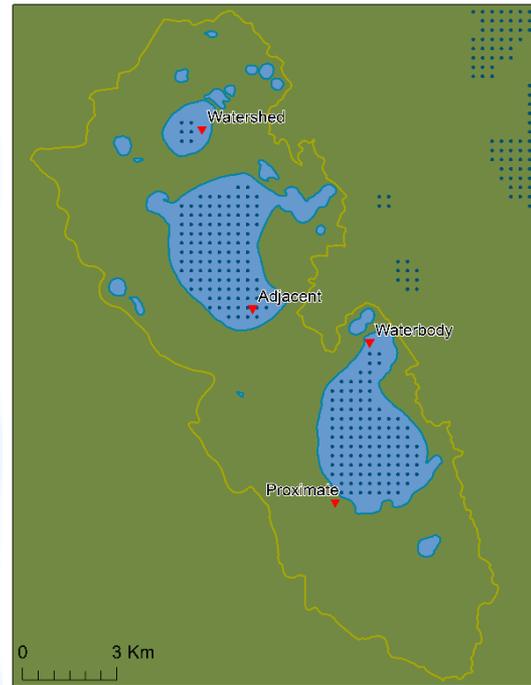
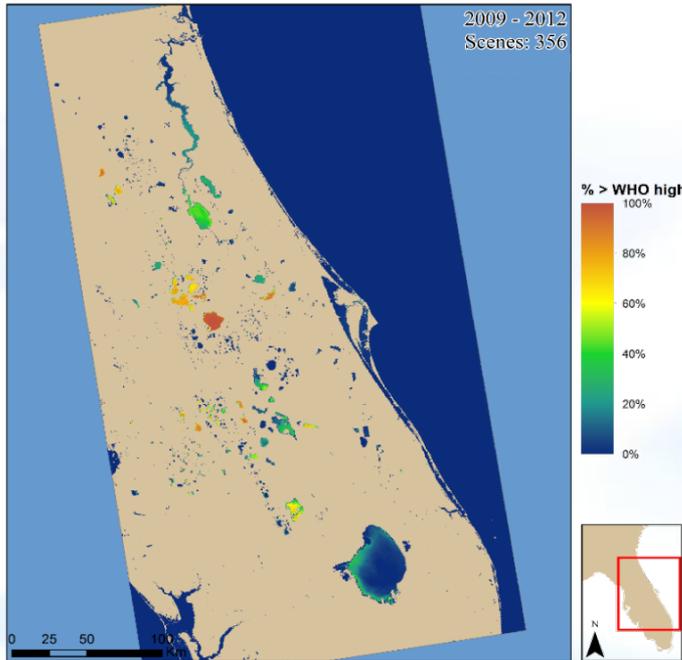


- Initial validation of Landsat 5/7 surface water temperature.



## Approach

- Statistical time series analysis of blooms in FL, OH, and CA (2008-2011)
- Heat maps and surface drinking water intake monitoring methods



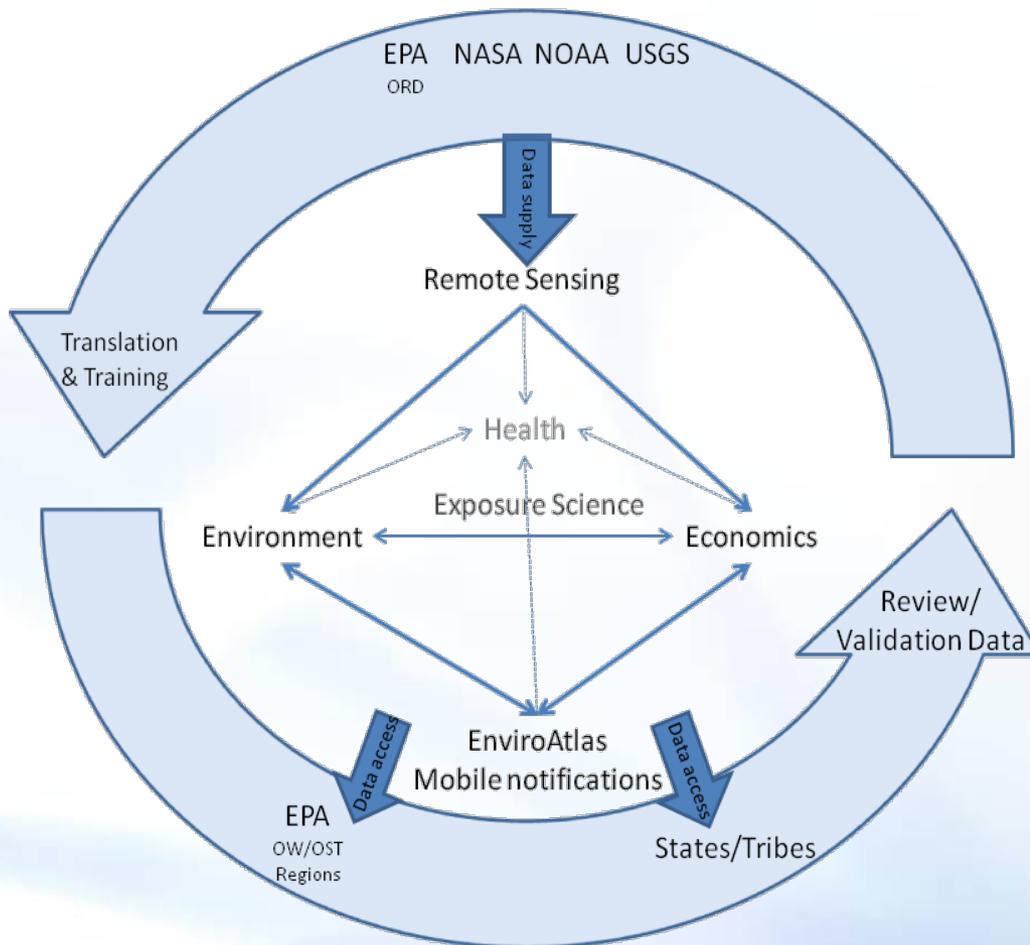


## Impacts

- ASDWA Drinking Water HABs and Toxins Discussion Group, 12/8/2014. Webinar.
- Inland HAB Discussion Group, 12/10/14. Webinar.
- OSTP subcommittee on Water Availability and Quality. 1/12/15
- EPA Region 4 State Agency Water Directors Meeting. April 14, 2015. Atlanta, Georgia.
- EPA Region 6 Regional Technical Assistance Group (RTAG) Meeting. May 13, 2015.
- Environmental Protection Agency Safe and Sustainable Waters Resources L'eau Down. June 8-10, 2015. Washington DC
- EPA Region 9 State Agency Water Directors Meeting. June 18, 2015. San Francisco, California.
- Office of Water, Office of Wetlands, Oceans and Watersheds 303(d) Nutrient Group. Webinar. June 23<sup>rd</sup>.
- Water Quality Monitoring. Water Cycle Strategy Meeting. Google Headquarters.
- Ann Dunkin EPA Chief Information Officer. Cincinnati, Ohio.
- EPA Region 8 Harmful Algal Bloom workshop. September 30-October 1, 2015. Rapid City, South Dakota.
- Harmful Algal Bloom and Hypoxia Research Control Act. Webinar. October 29, 2015.
- Regional Science Liaison Meeting with Office of Research and Development. CyAN mobile application demo. Cincinnati, OH. November 3<sup>rd</sup>.
- \*Crawford and Schaeffer. 2016. Using satellite remote sensing to derive numeric criteria in coastal and inland waters of the United States. Ocean Sciences Meeting. New Orleans, LA.
- EPA 2016 Recreational Waters Conference. New Orleans, LA April 12-15.
- EPA Region 8 HABs Webinar. February 25<sup>th</sup>, 2016.
- HAB Workgroup Meeting. New England Interstate Water Pollution Control Commission. Lowell, MA. March 15<sup>th</sup>, 2016. Conference line.
- EPA Region 10 Workshop. Seattle Washington. March 29-30<sup>th</sup>, 2016.
- EPA Region 5 HAB Workshop. Chicago, OH, April 27-28, 2016.



## Transition Strategy



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## Highlights

COMMITMENTS TO ACTION ON BUILDING A  
SUSTAINABLE WATER FUTURE



The Executive Office of the President

**The Columbus Dispatch**  
**THE BLADE**  
*One of America's Great Newspapers*



Agencies  
Collaborate,  
Develop a  
Cyanobacteria  
Assessment  
Network

By Blake A. Schaeffer, Keith Loftin, Richard P. Stumpf,  
and P. Jeremy Werdell

WIRE

Incredible Images of Algal Blooms Taken From Space

NEEL V. PATEL | SCIENCE | 04.08.15 | 2:22 PM

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**INCREDIBLE IMAGES OF ALGAL  
BLOOMS TAKEN FROM SPACE**



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EPA Issues Health Advisories to Protect Americans from Algal  
Toxins in Drinking Water



## Publications

Schaeffer, Loftin, Stumpf, & Werdell. 2015. Agencies collaborate to develop a Cyanobacteria Assessment Network (CyAN). *Eos, Earth and Space Science News*. Cover Article. 96(23): 16-20.

Mattas-Curry, Schaeffer, Conmy, and Keith. 2015. A space satellite perspective to monitor water quality using your mobile phone. *North American Lake Management Society Lake Line Magazine*. 35(2) 28-31.

Shao, Lunetta, Wheeler, liames, & Campbell. 2016. An evaluation of time-series smoothing algorithms for land-cover classifications using MODIS-NDVI multi-temporal data. *Remote Sensing of Environment*. 174:258-265.